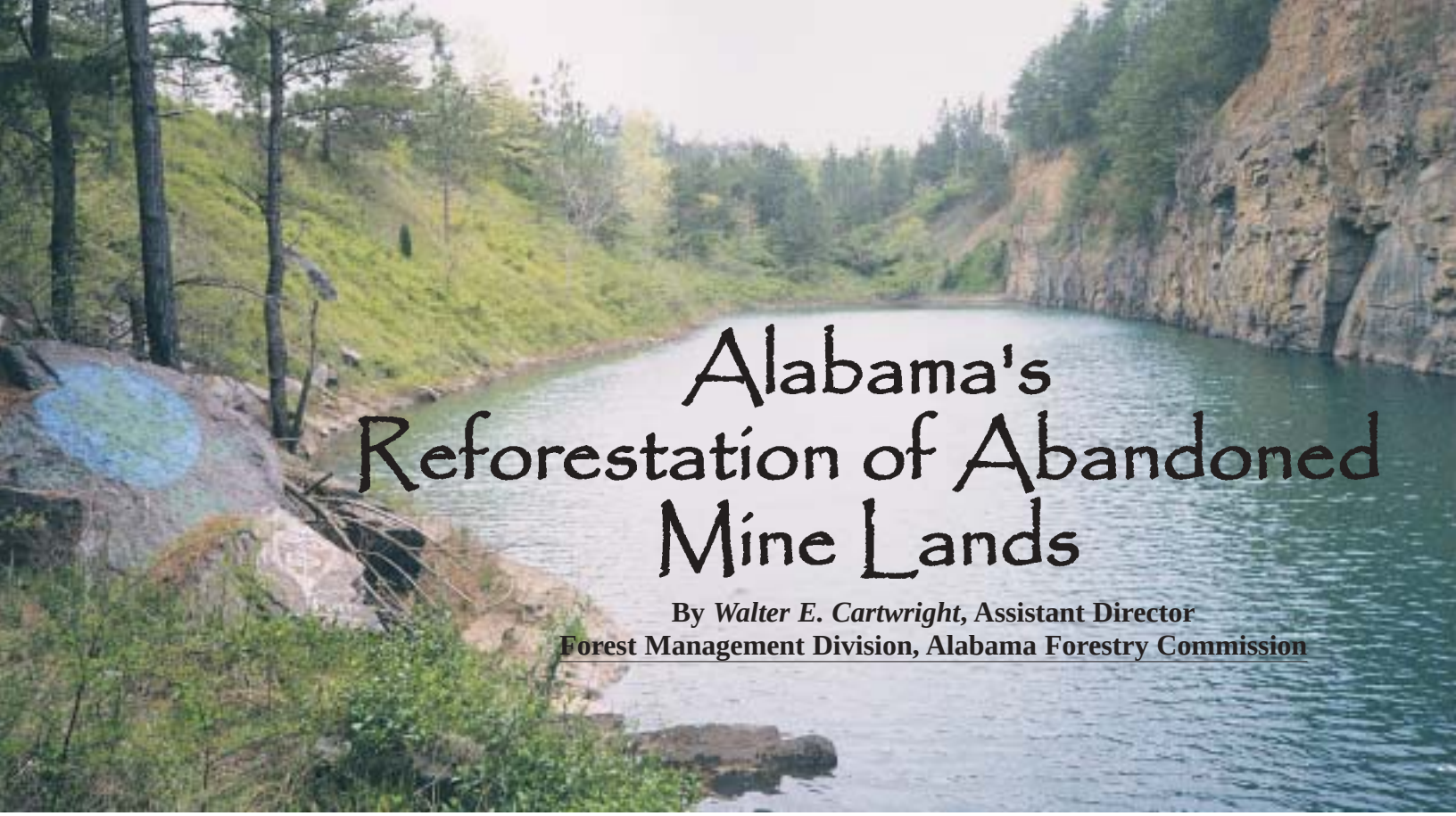

Alabama's Reforestation of Abandoned Mine Lands

By *Walter E. Cartwright*, Assistant Director
Forest Management Division, Alabama Forestry Commission

Reforestation of abandoned mine lands not only heals scars created by past surface coal mining to fuel the nation's wars and the Industrial Revolution, but also establishes young forests for many uses. As trees grow, carbon dioxide is removed and oxygen is added to the atmosphere; carbon is stored in wood tissue and raw material is grown for forest products; soil is stabilized and enhanced; water quality is improved; and widely varied wildlife habitat shelters many terrestrial and aquatic communities.

Alabama leads the way in reforesting abandoned mine lands. Since 1977, the state's Abandoned Mine Land (AML) Reclamation Program in the Department of Industrial Relations has been committed to reclaiming and re-vegetating previously mined lands, with 87% being reforested. Loblolly pines account for 85%, with the remaining plants and trees consisting of autumn olive, sawtooth oak, bicolor lespedeza, cherrybark oak, sycamore, yellow poplar, and other wildlife shrubs.

Over the past 100 years, large draglines ripped through the earth and rock to create huge spoil piles of "overburden," left to erode and be inhabited with grass, weeds, non-commercial shrubs, and a few pines and hardwoods. Most sites consist of rough, ungraded spoils, water impoundments, dangerous highwalls, coal refuse "gob" piles, as well as industrial and residential waste piles. Spoil piles are compacted by heavy equipment, heavy noxious weeds invade the site, and large rocks are scattered throughout the piles.

Naturally, all unwanted vegetation must be cleared, impoundments drained, and waste buried or removed to a solid waste landfill. Compaction must be reduced, especially in rows where trees will be planted.

Through the years, Alabama has developed a recipe for reforestation success:

- Proper site preparation
- Adding needed soil amendments
- Proper soil composition and moisture
- Rip and spray to reduce compaction to control competing vegetation
- Purchase quality seedlings from superior nurseries and take proper care of seedlings
- Use proper planting techniques and practice quality controls
- Plant seedlings at proper soil moisture and temperature

These ingredients must be discussed in some detail to explain how critical each and every one is to the reclamation process and final tree survival/growth.

Site Preparation

All impoundments are drained using ADEM-approved (Alabama Department of Environmental Management) de-watering procedures; unwanted vegetation is cleared and burned; trash and waste is buried on-site or transported to an approved landfill; then grading of spoils begins. All highwalls are backfilled with on-site spoil material, including impoundments, then sloped to a 3:1 or flatter slope. Slopes are stabilized by adding terraces at necessary intervals, which are protected by erosion control fabric or limestone riprap.

Soil Amendments

A comprehensive soil analysis is performed by certified soils laboratories to determine the type of amendments needed and quantities necessary for proper plant growth. In Alabama, large amounts of lime and high nitrogen fertilizer are required on most sites. These chemicals are spread, disked into the graded soils, and a mixture of native grasses and legumes is spread to germinate and stabilize the site until trees can be planted during the following winter. Heavy layers of hay mulch are spread and crimped to create a prime seed-bed while some areas are hydro-seeded with a mixture of wood pulp fiber, fertilizer, and grass seed.

Photo by Larry Barwick

Soil Composition and Moisture

Careful attention is devoted to the upper layer of soil in which roots of grasses, legumes, and seedlings must develop and survive, adding to the organic material and re-establishing topsoil. Hay mulch is added not only to hold seed and soil in place, but also to provide the initial head start on organic buildup in the soil. Proper amounts of mulch hold moisture in the soil, reduce sun and wind dehydration, and lessen erosion.

A mixture of Pensacola bahia grass, hulled common bermuda, hulled sericea lespedeza, browntop millet, and crimson clover are planted in spring and summer. A heavier mixture is planted in fall and winter, consisting of the same seed plus unhulled common Bermuda grass, unhulled sericea lespedeza, Kentucky 31 fescue, common annual ryegrass, and inoculated crimson and ladino clover. The mix of grasses works together to establish a thick root mass in the upper six inches of soil, while the legumes fix nitrogen in the soil, further promoting root growth and aiding soil micro-organisms in colonizing and building up organic matter over time. Site conditions vary across Alabama, so the mixture of grasses, legumes, and soil amendments is also tailored to each site, based on the comprehensive soil analysis.

Rip and Spray

As noted earlier, soil compaction, competing vegetation, and rocky soils are three limiting factors to successful re-vegetation and reforestation of graded mine spoils. A sub-soiler with a spray attachment was developed to spray a 4-foot swath along the ripped row where trees would be planted during the winter. Each row is ripped to a 14-inch depth and a 55-gallon herbicide mixture of 2.5 gallons of Roundup Pro, 10 ounces of Oust, and water is sprayed two feet on each side of the row. Ripping is done in October each year, opening a channel for planting bare root seedlings, moving rocks out of the row. Herbicides control competing vegetation to an acceptable level, allowing seedlings room to grow and develop a good root system during that critical first year. Rows are ripped on 10-foot spacings where possible, even in areas that require hand-planting, allowing trees to be planted on a 6-foot x 10-foot spacing to achieve 726 trees per acre. In Alabama, this step is critical to control weeds and grasses for good seedling survival. The soil amendments and mulch almost always produce a lush carpet of grasses, stabilizing each site until trees can be planted and grown producing a forest to permanently hold the site in place.

Seedling Quality and Care

Once the site is prepared, stabilized with grasses, ripped and sprayed, the next step is to procure quality tree seedlings that have an excellent chance of survival. On jobs of this magnitude, trees must be ordered six months to one year in advance of actual planting which allows tree nurseries to grow what their customers need.

Almost all tree nurseries in the Southeast are members of a pine plantation cooperative which continually produces superior seedlings from genetically-improved seed orchards across the region. Seedlings are grown in soil mediums consisting of sand clay loam, decomposed sawdust, and pisolithus tinctorius fungus. The fungus attaches to the feeder roots of seedlings in a symbiotic relationship, greatly increasing the plant's ability to uptake moisture and nutrients. Genetic improvement results in trees that are resistant to both fusiform rust and root rot. They have increased growth rates, resulting in good form and right-angled limbs that prune with the least amount of bole exposure.

Seedlings at superior tree nurseries are undercut in August of each year to force root systems to branch out. This produces a really fibrous root system to support seedlings during that critical first year of growth. Most nurseries also grade seedlings to discard trees with Cronartium cankers (fusiform rust), forked trees, and weak seedlings.

Seedlings are planted in January through March of each year, being picked up at the nurseries and transported in covered trucks, vans, or trailers to prevent dehydration from wind and sun exposure. The trees are stored on racks in a humid cold storage building (at temperatures 40-45 degrees), designed to keep them dormant and moist until planting. When transported to the site, the seedlings are covered and kept in shade to protect from sun and wind exposure, preserving moisture.

(Continued on page 16)


Photo by Jim L. Kitson


Photo by Michael R. Skates


Photo by Jim L. Kitson

The reclamation process on the abandoned sites includes draining impoundments and clearing debris. Highwalls are backfilled, sloped, and stabilized (top photo). After grading, amendments are added and all sites are planted in permanent grasses and legumes to stabilize the soil (center photo). During the following fall, rows are ripped with a sub-soiler on 10-foot intervals, and the herbaceous vegetation sprayed simultaneously to reduce competition. All areas are machine-planted where possible (bottom photo); steep slopes and wet areas are hand-planted.

Alabama's Reforestation of Abandoned Mine Lands

(Continued from page 15)

All this care is necessary to nurture seedlings until they are planted because each tree should be green, dormant, and healthy. They are, after all, "baby trees" and must be pampered somewhat. As we often say around planting sites, the best way to boost survival rates of trees planted is to "plant *live* trees." This may sound ridiculous; however, seedlings may be green and look fine, but be completely dead.

All trees planted are bare root, and include hardwoods and wildlife shrubs. Most pine trees are loblolly, but some sites are planted with longleaf pines at the owner's request.

Planting Techniques

In the beginning, contractors were hired to plant trees on reclaimed AML sites, which afforded little control over seedling quality, care, and planting techniques. Therefore, in 1987 the Alabama Department of Industrial Relations (ADIR) decided to take control of the reforestation program – planting good seedlings, properly, on all reclaimed sites. The Walker County Soil and Water Conservation District Board began planting seedlings under a long-standing cooperative agreement with ADIR's Mining and Reclamation Division. Survival rates improved dramatically, then, in 1991, a Reynolds F-050 split-axle tree planter was purchased. The planter foot and colter were modified and strengthened for harsh soil and rock conditions. Frequent care and maintenance have kept the planter functioning properly, and many years of operation on mine spoils is anticipated.

A dual-wheeled farm tractor is used to pull the planter along previously ripped rows. Workers riding in the planter place trees on 6-foot spacings, and another worker follows to straighten trees and plant skips in rows. Steep slopes are hand-planted with dibble bars, using proper planting techniques. A professional registered forester oversees the process, performing quality-control checks to guarantee proper planting, packing, spacing, and seedling care.

Soil Moisture and Weather

Cold weather and good soil moisture are critical to seedling survival and growth. Sites are monitored for proper planting conditions, and trees are planted during optimum conditions. Tree planting season is the number one priority when conditions are right, but planting will be suspended if soils become dry or the weather becomes too hot or cold. Surplus seedlings are returned to cold storage where they remain until adequate moisture and cold weather conditions return. Conditions vary widely across Alabama so crews can usually move to another location to continue planting, then return to a previous site as necessary. If soil amendments, mulch, and grasses have been added to graded mine spoils, organic matter will accumulate to hold soil moisture and provide much-needed nutrients for bare root seedlings. Moisture, organic material, and nutrients are concentrated in ripped trenches that have closed during the months prior to planting.

Seedling survival surveys are performed during the fall after planting to determine survival rates, health, growth, and any need for replanting. Such surveys are essential in monitoring any reforesta-

Reforestation and routine maintenance of reclaimed abandoned mine lands not only stabilizes the soil and ensures successful tree growth, but also provides cover and habitat for many wildlife species. While increasing land productivity, it also enhances the taxable value of property.

Photos by Rod Penuel

tion program and help identify problems such as poor planting techniques, weak seedlings, poor soil conditions, acid soils, and too much competing vegetation.

If all of the above ingredients are added to your reforestation recipe, you should have a successful program with good-to-excellent survival rates. Even during drought conditions, seedlings will survive and establish deep root systems to catapult them upward during the next spring growth season.

The Mining and Reclamation Division also surveyed older pine plantations for survival rates, growth, and stand density. Site index is good-to-excellent after reforestation and shows all indication that the new site index will be as good, or better, than the pre-mined site index. For example, many 11-year-old trees are 30-40 feet high and 6-8 inches in diameter at breast height. Projections to age 50 would not be reliable at this point, but all indications are excellent to show improvements over the original site index.

A study was completed in 1999 on 27 sites chosen at random by Dr. E. Sam Lyle, Jr., retired soil scientist, and Jim L. Kitson, Supervisor of the Walker County Soil and Water Conservation District Board in Boldo, Alabama. The results showed survival ranges from 77.0 to 99.7%, with an overall average of 86.1%. The study also showed decreased survival rates with age; however, stands naturally lose unhealthy and undesirable trees, allowing the survivors opportunity to grow better without the added competition. Forest industry in Alabama establishes an average 726 trees per acre during planting, and desires an average 500 trees per acre at age five. Studies have shown that the maximum basal area of tree volume can be achieved at that stocking rate. Dr. Lyle's study revealed that reclaimed sites had more than 500 trees per acre surviving at age five.

The owners of the reclaimed mine lands have the option to thin plantations at ages 10-12 years, 20-25 years, and final harvest at age 30. ADIR has no control over the landowners' timber stand management, but provides them with healthy, quality forests to manage for wood production, recreation, and wildlife management. Many landowners are now having their forests certified through the Tree Farm Program and TREASURE Forest Program which require frequent and professional management.

This past year another successful tree planting season was completed by the ADIR on the state's abandoned mine lands. During the 2003-2004 tree planting season, 73,000 seedlings were planted (including loblolly pine, sawtooth oak, and various wildlife-food shrubs) on 134 reclaimed acres across 6 counties. The seedlings were planted by the Walker County Soil and Water Conservation District Board through a cooperative agreement with ADIR. The table below shows that since ADIR began reclaiming abandoned mines in 1976, over 7 million trees have been planted on 9,634 acres of reclaimed lands in 14 north Alabama counties.

A recent survey by the Interstate Mining Compact Commission of states' reforestation efforts indicated that Alabama leads the nation in both number of trees planted on abandoned mine lands, as well as highest survival rate after planting. This achievement is due to the availability of top-quality, genetically-improved seedlings, proper care and handling, supervision by qualified reclamation inspectors and registered foresters, and superior tree planting methods employed by the Board.

Although the Mining and Reclamation Division has reclaimed nearly 10,000 acres of abandoned mines, much work remains to be done. An estimated $450 million is needed to reclaim all remaining sites in Alabama to eliminate these scars, safety hazards, and environmental problems.

Editor's Note: For more information on Alabama's Abandoned Mine Land Reclamation Program, contact Michael R. Skates, Director, Mining and Reclamation Division, Alabama Dept of Industrial Relations, 649 Monroe Street, Montgomery, AL 36131-5200; telephone: (334) 242-8265; or email: mskates@dir.state.al.us.

TREE PLANTING SUMMARY
TVA Orphan Mine Land Reclamation Program (1976 - 1980)
and Abandoned Mine Land Reclamation Program (1983 - 2004)

County	Acreage Treated	Pines	Wildlife Shrubs	Other*	Total Seedlings
Bibb	209	116,130	15,100	12,630	143,860
Blount	1,244	505,529	214,300	13,850	733,679
Cullman	389	96,300	167,300	4,300	267,900
DeKalb	40	25,450	0	200	25,650
Fayette	58	43,125	400	1,200	44,725
Franklin	27	19,650	1,450	1,600	22,700
Jackson	283	53,000	67,000	0	120,000
Jefferson	741	502,513	51,600	35,600	589,713
Lamar	29	11,800	1,500	1,800	15,100
Marion	1,414	578,600	221,700	2,800	803,100
St. Clair	152	82,000	6,200	9,810	98,010
Tuscaloosa	884	530,600	71,500	54,700	656,800
Walker	2,602	1,705,849	656,800	28,160	2,390,809
Winston	1,562	927,684	421,100	6,350	1,355,134
TOTALS	9,634	5,198,230	1,895,950	173,000	7,267,180

**Sawtooth oak, cherry bark oak, white oak, sycamore, yellow poplar, etc.*